Geophysical Research Abstracts, Vol. 6, 06177, 2004
SRef-ID: 1607-7962/gra/EGU04-A-06177

ON THE PROPERTIES OF COHERENT WAVES AT THE PROTON CYCLOTRON FREQUENCY AT MARS

C. Mazelle (1), C. Bertucci (1), K. Sauer (2), E. Dubinin (2) and M. H. Acuna (3)

(1) Centre d'Etudes Spatiales des Rayonnements, 9 Avenue du Colonel Roche, Toulouse, 31400, France (christian.mazelle@cesr.fr; (33)561556701), (2) Max-Planck-Institut für Aeronomie, Katlenburg-Lindau, Germany, (3) NASA Goddard Space Flight Center, Greenbelt, MD, USA

The observation of low frequency waves at the cyclotron frequency of an ion species in the vicinity of a solar system body surrounded by a neutral atmosphere or exosphere reveals its micro-scale interaction with the solar wind. They are frequently used to derive constraints on the neutral species density upstream from the body using linear growth rate or quasi-linear theory predictions for the wave saturation level. Low frequency waves at the proton cyclotron frequency are very frequently observed by the MAGER experiment onboard Mars Global Surveyor(MGS) in the plasma environment of Mars. The waves are left-handed circularly polarized in the spacecraft frame. Their wave vectors lie at moderate but oblique angles from the ambient magnetic field and the observed periods (spacecraft frame) always closely fit the local proton cyclotron periods. Morover, these waves are very frequently revealed as wave packets with a more or less regular modulation in amplitude with a typical time scale of 5 to 10 gyroperiods. We have solved the Maxwell-Vlasov linear dispersion relation using realistic parameters for the Martian environment and we show that these waves occur when the plasma is linearly unstable with respect to the resonant ion/ion beam instability fed by the planetary pick-up protons. The waves can have large amplitude (up to 5 nT peak-to-peak) even at large distance from the planet. We show that they can be identified at more than 11 R_M from the planet. The large observed amplitudes seem difficult to reach e.g., from the nonlinear saturation of the proton cyclotron instability using realistic pickup ion densities from up-to-date exosphere models. These waves have been interpreted as 'oscillitons', i.e. nonlinear stationary structures in the bi-ion

plasma but apparent as temporal structures in the spacecraft frame. They can be produced by the existence of two ion populations (solar wind and planetary) with different densities, velocities and/or temperatures. This also implies that direct connection between wave amplitude at the cyclotron frequency and neutral densities in the planetary exosphere is not straightforward. We present new results on these Martian oscillitons and discuss their relation with other waves observed upstream from the Martian bow shock.